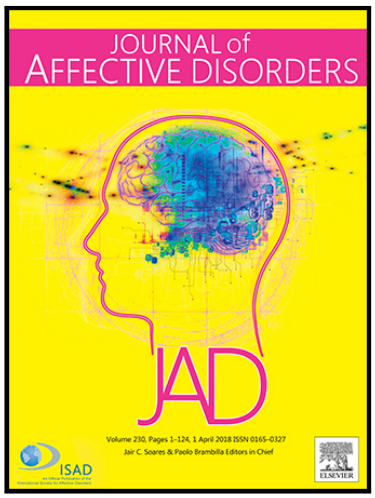

Method of self-harm and risk of self-harm repetition: findings from a national self-harm registry

G Cully , P Corcoran , D Leahy , E Griffin , C Dillon , E Cassidy , F Shiely , E Arensman

PII: S0165-0327(18)31296-5
DOI: https://doi.org/10.1016/j.jad.2018.10.372
Reference: JAD 10319

To appear in: *Journal of Affective Disorders*

Received date: 20 June 2018
Revised date: 14 September 2018
Accepted date: 5 October 2018

Please cite this article as: G Cully , P Corcoran , D Leahy , E Griffin , C Dillon , E Cassidy , F Shiely , E Arensman , Method of self-harm and risk of self-harm repetition: findings from a national self-harm registry, *Journal of Affective Disorders* (2018), doi: https://doi.org/10.1016/j.jad.2018.10.372

Highlights

- Methods associated with increased risk of self-harm repetition were minor and severe self-cutting, intentional drug overdoses (IDOs) involving multiple drugs including psychotropic drugs and self-harm by blunt object.
- Minor self-cutting was the method associated with highest repetition risk.
- Repetition risk was similar following IDOs of four or more drugs involving psychotropic drugs, severe self-cutting and blunt object.

Method of self-harm and risk of self-harm repetition: findings from a national self-harm registry

Cully G[1,21], Corcoran P[1,2], Leahy D[1,2], Griffin E[2], Dillon C[2], Cassidy E[3,4], Shiely F[1,5], Arensman E[1,2].

[1]School of Public Health, University College Cork, Cork, Ireland.

[2]National Suicide Research Foundation Ireland, Cork, Ireland.

[3]Liaison Psychiatry Service, Cork University Hospital, Cork, Ireland.

[4]Department of Psychiatry and Neurobehavioural Science, University College Cork, Cork, Ireland.

[5]HRB Clinical Research Facility, Mercy University Hospital, Cork, Ireland.

Abstract

Background: Risk of self-harm repetition has consistently been shown to be higher following self-cutting compared to intentional drug overdose (IDO) and other self-harm methods. The utility of previous evidence is limited due to the large heterogeneous method categories studied. This study examined risk of hospital presented self-harm repetition according to specific characteristics of self-harm methods.

Methods: Data on consecutive self-harm presentations to hospital emergency departments (2010-2016) were obtained from the National Self-Harm Registry Ireland. Associations between self-harm method and repetition were analysed using survival analyses.

Results: Overall, 65,690 self-harm presentations were made involving 46,661 individuals. Self-harm methods associated with increased repetition risk included minor self-cutting, severe self-cutting, multiple drug IDOs involving psychotropic drugs and self-harm by blunt object. Minor self-cutting was the method associated with highest repetition risk (adjusted hazard ratio (AHR) 1.38, 95% CI 1.31-1.45). Risk of repetition was comparable following IDOs of four or more drugs involving psychotropic drugs (AHR=1.29, 95 % CI 1.20-1.39), severe self-cutting (AHR 1.25, 95% CI 1.16-1.34) and blunt object (AHR=1.23, 95% CI 1.07-1.42).

Limitations: Information was not available on suicide or other causes of mortality.

[1] **Corresponding author:** Grace Cully

Postal address: National Suicide Research Foundation, 4.28 Western Gateway Building, University College Cork, Cork, Ireland

Email: grace.cully@ucc.ie

Telephone: +353214205545

Conclusions: Self-harm method and the associated risk of repetition should form a core part of biopsychosocial assessments and should inform follow-up care for self-harm patients. The observed differences in repetition associated with specific characteristics of IDO underline the importance of safety planning and monitoring prescribing for people who have engaged in IDO.

Key words: Self-harm, self-harm method, self-harm repetition, risk factor, risk assessment, mental health

Self-harm is one of the strongest risk factors for both non-fatal self-harm repetition and suicide (Carroll et al., 2014; Chan et al., 2016; Larkin et al., 2014b). The individual, societal and economic cost associated with self-harm is significant and increases with repetition (Sinclair et al., 2011). To aid clinicians in planning treatment and follow-up, it is important to understand the factors that are associated with increased risk of self-harm repetition (Health Service Executive, 2017; NICE, 2004, 2011). Method of self-harm has been widely investigated as a risk factor for repetition and self-cutting is the only method consistently associated with repeated self-harm (Larkin et al., 2014b). The utility of the evidence emerging from research examining self-harm method as a risk factor for repetition is limited because methods are classified into large heterogeneous groups, most commonly intentional drug overdose (IDO) and self-poisoning combined and self-cutting (Bergen et al., 2010; Birtwistle et al., 2017; Lilley et al., 2008). More detailed examination of self-harm methods has the potential to enhance our understanding of their relationship with non-fatal repetition (Birtwistle et al., 2017).

Intentional drug overdose (IDO) is the most common method of hospital presented self-harm, involved in more than two thirds of presentations (Arensman et al., 2018; Geulayov et al., 2016; Perry et al., 2012). Previous studies reported lower risk of self-harm repetition following IDO compared to self-cutting and similar risk compared to other types of self-injury (Bergen et al., 2010; Birtwistle et al., 2017; Lilley et al., 2008; Perry et al., 2012). However, episodes of IDO are not homogeneous in terms of clinical characteristics and medical severity. Increased number of tablets and multiple drugs taken in IDO are associated with higher levels of suicidal intent (Haw et al., 2015; Townsend et al., 2001), more extensive medical intervention and greater risk of fatality (Hori and

Kinoshita, 2016; Neeleman and Wessely, 1997). Specific characteristics of IDOs have been largely overlooked in large scale prospective studies of self-harm. One study, conducted over 20 years ago, found that ingestion of more than one drug was associated with increased risk of IDO repetition (Owens et al., 1994). In addition, use of benzodiazepines in IDO has been found to be a significant predictor of short term risk of repetition (Cooper et al., 2006).

Self-cutting is involved in approximately 20% of self-harm presentations to hospital (Birtwistle et al., 2017; Hawton et al., 2007; Perry et al., 2012). Hospital presentations resulting from self-cutting can vary widely in terms of injury severity (Larkin et al., 2014a). So far, only one study has examined the severity of self-cutting and repetition of self-harm observing that increased severity was associated with reduced self-harm repetition overall but the authors noted an increased risk of repetition using high lethality methods (Larkin et al., 2014a). The relationship between repetition risk and self-cutting severity has not been examined in comparison with any other self-harm methods. Other methods of self-harm, such as attempted hanging, attempted drowning and self-harm with a blunt object, have received little individual consideration in relation to risk of non-fatal repetition.

Within this context, the present study examined the risk of self-harm repetition according to the characteristics of self-harm method(s) involved in an index self-harm presentation using national self-harm surveillance data from hospital emergency departments (EDs).

METHODS

Setting and sample

The National Self-Harm Registry Ireland (NSHRI) collects data on consecutive patients who present to EDs as a consequence of self-harm. Since 2006, the NSHRI has full national coverage of all 36 acute hospitals in Ireland.

The NSHRI uses the following definition of self-harm 'an act with non-fatal outcome in which an individual deliberately initiates a non-habitual behaviour, that without intervention from others will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognised therapeutic dosage, and which is aimed at realising changes that the person desires via the actual or expected physical consequences' (Platt et al., 1992). The definition includes acts involving varying levels of suicidal intent and various underlying motives. Presentations involving acts without intention to self-harm, including accidental overdoses of medication, street drugs or alcohol, are not recorded in the NSHRI. All self-harm presentations to the ED are included in the NSHRI data irrespective of whether the presentation results in hospital admission. More information on data collection and quality assurance has been reported elsewhere (Perry et al., 2012).

Analyses were conducted for presentations recorded between 1 January 2010 and 31 December 2016. The dataset were restricted to individuals who did not present to hospital with self-harm during 2007-2009, in order to maximise the number of true first presentations after 1 January 2010. A similar method was used by Perry et al. (2012). All repeat presentations, rather than first repeat presentations only, were included in the analyses with each repeat presentation becoming an index presentation.

Data items

Data Registration Officers (DROs) collect data on self-harm presentations according to standardised methods of case ascertainment and definition. The following core data items routinely collected by the DROs were accessed: demographic characteristics (age and sex), method(s) of self-harm, alcohol involvement. Self-harm repetition was defined as a presentation to an ED as a result of a self-harm act following an index self-harm presentation at any time during the 7-year study period. All repeated self-harm presentations were included in the definition of self-harm repetition irrespective of method involved in the repeat act. Encrypted patient initials, sex and date of birth were used to differentiate between self-harm patients and to identify repeat presentations by the same patients. Self-harm presentations by the same individual occurring on the same day were recorded once to ensure that all presentations represented distinct events. Only individuals who had no self-harm

presentation in the 3 years prior to the study period were included in the analyses. The study examined all presentations (including first and repeat presentations) as index presentations using repeat event analysis. Self-harm history reflected the number of presentations an individual had prior to an index presentation during the study period.

Method of self-harm was recorded according to the Tenth Revision of the WHO's International Classification of Diseases (ICD-10) codes for intentional injury (World Health Organization, 2008). IDO was defined as the intentional ingestion of more than the prescribed or recommended dose of any drug, as well as IDO of illegal drugs (ICD codes X60-X64). IDO was categorised according to patient-reported number of tablets, number of drugs and class of drugs taken. Categories of drug class were psychotropic drugs, analgesic drugs and other prescription or over-the-counter drugs. Psychotropic drugs included: minor tranquilisers, major tranquilisers, barbiturates/anti-epileptic drugs, antidepressants, and other mood stabilisers. Analgesic drugs included: paracetamol, opiates, salicylates, non-steroidal anti-inflammatory drugs (NSAIDs). Analgesic and opiate drug groups include compound drugs. Self-poisoning was defined as the ingestion of substances other than drugs, including organic solvents, pesticides, gases and other noxious substances, with non-ingestible chemical substances (ICD codes X66-X69). Self-cutting severity was operationalised according to treatment received. Minor self-cutting included injuries that required no treatment, wound cleaning or steri-strips only while severe self-cutting included injuries that required sutures or plastic surgery referral. Self-harm by blunt object (ICD code X79) included self-battery and head-banging. Analyses were based on method involvement rather than primary or sole method. Where multiple methods were involved in a self-harm presentation, up to 5 methods were recorded.

Statistical analyses

Cox proportional hazard models were fitted to estimate time to self-harm repetition according to the following method variables: number of tablets, number of drugs and class of drugs taken in IDO, self-cutting severity, blunt object, attempted hanging, attempted drowning, self-poisoning with non-ingestible substances, jumping from a height, crashing a motor vehicle and lying or jumping in front of a moving object. To analyse multiple methods involved in each presentation, methods were included in analyses as separate variables with "all other methods" as the reference category. Number of tablets, number of drugs, and class of drugs taken in IDO were examined separately in univariate models. To avoid collinearity, these characteristics of IDOs were entered as a combined variables in multivariate models (number of drugs / number of tablets and number of drugs / class of drugs) The following co-variates were included in the multivariate model: sex, age, alcohol involvement and self-harm history. Adjusted Hazard ratios (AHR) with 95% confidence intervals (95%

CI) were calculated. To further illustrate the findings, Kaplan-Meier curves were plotted, truncated at 24 months.

Follow-up time after an index self-harm presentation varied depending on the point during the study period when the presentation occurred due to the fixed final date, 31 December 2016, ranging from 1 day to 7 years. Variable length of follow-up was accounted for in the analyses. The study used repeat event analyses in that all repeat presentations, were included in the analyses with each repeat presentation becoming an index presentation. Lack of independence of observations between presentations made by the same individual was adjusted for by using robust analyses that modified the variance of estimates.

Nelson Aalen graphical tests showed reasonably parallel lines indicating that the assumption of proportional hazards was upheld. The assumption was tested using post-estimation statistics on the basis of Schoenfeld residuals (Grambsch and Therneau, 1994). The post estimation statistics were statistically significant for some variables. However, Spearman's Rho coefficients were small (ranging from .015 to .057) indicating little violation of the proportional hazards assumption. Analyses were carried out using SPSS 22 and Stata 12 for Windows.

Ethics statement

Ethical approval for the NSHRI was granted by the National Research Ethics Committee of the Faculty of Public Health Medicine. Ethical approval was also received from the relevant hospital or Health Service Executive ethics committees.

RESULTS

A total of 65,690 self-harm presentations by 46,661 individuals were made to hospital EDs in Ireland from 2010 to 2016 (Table 1). The majority of presentations (41.3%) were made by patients in the 25-44 year age range (mean age=32.7, SD±14.4). 53.4% of presentations involved females. The most common self-harm method was IDO (68.3%) followed by self-cutting (23.8%), attempted hanging (6.6%) and attempted drowning (3.0%) (Table 1). IDO was more common among females (74.8% vs 60.9%, p<0.001). All other methods examined were more common among males (p<0.001): self-cutting (26.2% vs 21.7%), attempted hanging (10.0% vs 3.6%), attempted drowning (3.9% vs 2.3%), self-poisoning (2.4% vs 1.7%), jumping from a height (1.7% vs 0.9%), blunt object (1.1% vs 0.1%), jumping from a moving object (0.9% vs 0.5%) and crashing a motor vehicle (0.6% vs 0.3%). Approximately half of IDOs involved one drug (53.8%) and 46.8% involved less than 30 tablets. Psychotropic drugs were the most common drug class, involved in 45.2% of IDOs. Most self-cutting presentations were minor self-cutting (66.0%).

Self-harm repetition

During the seven years follow-up, 29.0% of episodes were followed by a repeat self-harm presentation. The median number of repeat presentations was two (interquartile range±1).

Self-cutting

Incidence of repetition was highest following self-cutting compared to all other methods (36.1% vs 26.7% respectively; χ^2=18.3, p<.001). Repetition occurred following 37.7% of minor and 35.2% of severe self-cutting presentations (Table 1). Self-harm repetition was more frequent and occurred earlier following minor compared to severe self-cutting (Figure 1a). In adjusted survival analysis, both minor (AHR 1.38, 95% CI 1.31-1.46) and severe self-cutting were predictive of self-harm repetition (AHR 1.25, 95% CI 1.16-1.34) (Table 2). Minor self-cutting was associated with higher risk of repetition compared to severe-self-cutting (AHR 1.11 95% CI 1.03-1.20, p=0.007).

Intentional drug overdose

Overall, incidence of repetition was lower following IDO compared to non-IDO presentations (27.7% vs 31.7% respectively; χ^2=111.4, p<.001). A repeat self-harm episode occurred following 26.3% of IDOs that involved a single drug only. Repetition was more likely following multiple drug IDOs. A subsequent self-harm presentation occurred following 32.9% of IDOs of four or more drugs (Table 1). Approximately 26% of IDOs involving less than 30 tablets were followed by a repeat self-harm presentation while approximately 30% of IDOs of 30 or more tablets were followed by a repeat episode (Table 1). Repetition occurred more frequently following IDOs that involved psychotropic

compared to analgesic drugs (30.1% vs 25.1% respectively) (Table 1). The relationships between self-harm repetition and the specific types of psychotropic and analgesic drugs are presented in detail in Supplementary Table 1. The Kaplan-Meier curves (Figure 1b, 1c and 1d) show the cumulative probability of a repeated self-harm presentation in the 24-month period after an index IDO presentation. Figure 1b illustrates that repetition risk following IDO increased with each additional drug taken. The curves in Figure 1c highlight a pattern of earlier and more frequent repetition following IDOs of 30 or more tablets compared to those involving less than 30 tablets. Figure 1d demonstrates higher repetition risk following IDOs involving psychotropic drugs compared to non-psychotropic IDOs.

In adjusted survival analysis, with number of drugs and class of drug combined, multiple drug IDOs involving psychotropic drugs were associated with increased risk compared to single drug IDOs that did not involve psychotropic drugs. IDOs involving four or more drugs, at least one of which was a psychotropic drug, were associated with 29.3% increased risk of repetition (AHR=1.29, 95 % CI 1.20-1.39). In further adjusted survival analysis, when combined with number of drugs taken, number of tablets taken did not contribute substantially to repetition risk (Supplementary Table 2).

Other Methods

Incidence of repetition was higher after an episode of self-harm by blunt object compared to other self-harm methods (34.8% vs 28.9% respectively; χ^2=9.9, p=.002) (Table 1). Repetition was significantly lower following self-poisoning compared to other methods (23.7% vs 29.1% respectively; χ^2=18.3, p<.001) and crashing a motor vehicle compared to other methods (19.8% vs 29.01% respectively; χ^2=11.3, p<.001). In adjusted survival analysis, self-harm by blunt object was an independent predictor of self-harm repetition, associated with a 23.3% increase in risk compared to presentations not involving a blunt object (AHR=1.23, 95% CI 1.07-1.42) (Table 2). Self-poisoning was associated with a 15.5% decrease in repetition risk compared to other methods (AHR=0.85, 95% CI 0.76-0.96).

Sex, age and self-harm history

There were no significant sex differences in incidence or risk of self-harm repetition (Table 1 and 2). 28.8% of males and 29.1% of females repeated. When risk of repetition was examined separately by sex, the relationship between self-harm method and repetition was broadly similar (Supplementary Table 3). However, there were some minor differences. In adjusted survival analyses, attempted hanging and jumping in front of a moving object were associated with increased risk of repetition among females but not males (Supplementary Table 3).

Repetition was most likely in the 25-44 years age group (30.6% repeated) and least common among those aged 65 or older (14.3% repeated) (Table 1). In adjusted survival analyses, compared to the 25-44 group, repetition was 41.5% less likely in the 65 or older age group (AHR 0.59 95% CI 0.51-0.67) and 6.1% less likely in the 45-64 age group (AHR 0.94 95% CI 0.89-0.99) (Table 2). Overall, risk of repetition was highest among those aged less than 15 years with an increased risk of 17.0% compared to those aged 25-44 years (AHR 1.17 95% CI 1.07-1.28). Consistent with the overall findings, females in the <15 years age group had the highest risk of repetition; however, males aged 15-24 years were the age group with the highest risk of repetition (Supplementary Table 3).

Repetition risk was significantly higher among patients who had at least one previous self-harm presentation (Table 1 and 2). Repetition risk increased with each additional previous self-harm presentation, with the highest risk following presentations among those with a history of four or more previous presentations (AHR 8.93, 95% CI 8.26-9.63). Figure 2 shows the proportion of repeat self-harm presentations by number and class of drug taken in IDO, severity of self-cutting and previous self-harm history. The graph highlights the overlap in incidence of repetition following self-cutting and IDOs that involved at least four drugs, including psychotropic drugs, a pattern that remained consistent as the number of previous self-harm presentations increased. Figure 2 also illustrates that previous self-harm history was associated with the greatest difference in repetition.

DISCUSSION

Main findings

This study provides the largest, most in-depth study of the association between method of self-harm and risk of non-fatal repetition using nationally representative data from hospital EDs. Self-harm methods associated with increased repetition risk included minor self-cutting, severe self-cutting, multiple drug IDOs that involved psychotropic drugs and self-harm by blunt object. Minor self-cutting was associated with the highest risk of repetition. Repetition risk was comparable following severe self-cutting, IDOs of four or more drugs that involved psychotropic drugs and self-harm by blunt object. **Findings in relation to previous studies**

We found that the relationship between repetition risk and IDO varied according to number and class of drugs taken. When psychotropic drugs were taken in IDO, involvement of multiple drugs was associated with increased risk of repeated self-harm compared to single drug IDOs. This builds on the findings of one previous study of hospital presented IDO which reported that risk of IDO repetition was higher among those who had taken more than one drug (Owens et al., 1994). Consistent with our findings, a previous UK-based study identified benzodiazepines, one of the most common psychotropic drugs used in IDO (Daly et al., 2018; Geulayov et al., 2016), as a significant predictor of short term repetition (Cooper et al., 2006). Psychotropic drug involvement in IDO is more common among those who are in receipt of a prescription for these drugs and in contact with psychiatric services (Corcoran et al., 2013; Tournier et al., 2009). Psychiatric treatment at the time of a self-harm episode is associated with increased risk of subsequent repetition (Larkin et al., 2014b).

IDO is frequently considered a method associated with lower risk of continued self-harm compared to self-cutting (Bergen et al., 2010; Birtwistle et al., 2017; Lilley et al., 2008; Perry et al., 2012). Overall, we found that incidence of repetition following IDO was significantly lower than self-cutting. However, the previously accepted disparity in repetition risk between self-cutting and IDO was not evident when IDO was categorised according to number of drugs and class of drug taken and self-cutting categorised according to severity. In our study, repetition risk was similar following IDOs of four or more drugs that involved psychotropic drugs and severe self-cutting, which has not been addressed by previous studies. These findings indicate that IDO should not be treated as a homogeneous category when considering the method used in relation to the assessment of risk in a clinical setting. This is further supported by the fact that multiple drug IDOs and increased number of tablets are associated with higher suicidal intent (Haw et al., 2015; Townsend et al., 2001), severe medical outcomes (Hori and Kinoshita, 2016; Neeleman and Wessely, 1997) and subsequent suicide (Carter et al., 2005).

Minor self-cutting was the method associated with highest risk of subsequent repetition. This finding compliments a previous study that reported higher risk of repetition following self-cutting requiring little or no treatment compared to self-cutting requiring more extensive medical intervention (Larkin et al., 2014a). Larkin et al. observed that use of lethal methods in repeat self-harm was associated with severity of self-cutting (Larkin et al., 2014a). If this potential escalation in method lethality resulted in an increase in fatal outcomes from self-harm acts that followed severe self-cutting, this may partly explain the reduction in overall repetition risk associated with severe compared to minor self-cutting. However, this has not been examined in previous studies. Differences in future risk according to cutting severity may also be influenced by differences in assessment and treatment (Larkin et al., 2014a). Patients who are admitted to hospital are more likely to receive a psychosocial assessment compared to those who are discharged directly from the ED (Lilley et al., 2008). Those with more extensive injuries as a result of self-cutting may be more likely to be admitted, which could increase the likelihood of receiving a psychosocial assessment which is associated with reduced risk of self-harm (Bergen et al., 2010).

Self-harm by blunt object was associated with increased risk of repetition. This is a novel finding as repetition following self-harm by blunt object has not been independently examined previously. These findings indicate that, consistent with minor self-cutting, this method of self-injury is associated with ongoing distress despite the likelihood that the resulting physical injuries require minimal medical treatment. However, it is important to note that this self-harm method is relatively uncommon, involved in just 1% of presentations in this sample. Overall other self-harm methods, including attempted hanging, attempted drowning, self-poisoning, jumping from a height, crashing a motor vehicle and jumping in front of a moving object, were not associated with increased repetition risk. The relationship between these methods and non-fatal repetition has received little individual consideration in previous studies. The absence of repetition risk following these methods should not be considered reflective of a profile of reduced risk as they are associated with high lethality (Mergl et al., 2015) and increased risk of subsequent suicide (Bergen et al., 2012; Runeson et al., 2010). Among females, there was some evidence of an increased risk of repetition following two of the high lethality methods, jumping in front of a moving object and attempted hanging, which are less common among females compared to males (Mergl et al., 2015). Previous research has found that involvement of lethal methods in a self-harm episode increases risk of subsequent suicide among males but not females (Skogman et al., 2004). Furthermore, method-specific lethality is higher among males (Mergl et al., 2015). Thus, it is possible that males who engaged in high lethality methods may have been more likely to have a fatal repeat episode. This could partly account for the

increased risk of non-fatal repetition associated with two high lethality methods among females but not males.

Strengths and limitations

This study used data from a national surveillance system including all self-harm presentations to hospital EDs over a seven-year period. The large sample size allowed for the examination of risk factors for self-harm repetition that have received limited attention in previous research. Due to the complete national coverage of hospital-presented self-harm, loss at follow-up was minimised. Analyses were limited to individuals with no self-harm presentation in the 3 years prior to the study period to maximise the likelihood that first patient presentations included in the analyses were first ever presentations. This reduces the potential for results to be biased by lack of information on self-harm history. All repeat presentations, rather than first repeat presentations only, were examined in the sample to avoid an underestimation of repetition (Lilley et al., 2008). However, because individuals commonly switch methods of self-harm from one episode to the next, results from analyses using repeat event analysis need to be interpreted with care (Birtwistle et al., 2017; Owens et al., 2015). There were some limitations to the study. This study focuses on hospital cases of self-harm only. Therefore, findings cannot be generalised to self-harm repetition not resulting in a hospital presentation. A further limitation relates to missing data: number of tablets taken in IDO and treatment for self-cutting were not recorded in a substantial proportion of presentations (28.7% and 12.1% respectively) as the variables were not always recorded in the case notes. Furthermore, information on toxicology of IDOs was not available. Consequently, data on drugs taken and quantity of tablets taken was based on self-report. In addition, information is not available from the NSHRI on drugs prescribed to the patient at the time of the IDO. It was, therefore, not possible to examine the impact of access to certain drugs and involvement in IDO. Finally, information on suicide or other causes of mortality is not recorded by the NSHRI. Therefore, cases will have been included in the analyses that should have been censored due to loss of life. As risk of suicide differs according to method of previous non-fatal self-harm (Bergen et al., 2012; Runeson et al., 2010), it is likely that this will have influenced our results.

Implications

This study found that non-fatal self-harm repetition differs according to specific characteristics of the index self-harm method(s). This highlights that detailed consideration of method of self-harm should form a routine part of psychosocial assessment and management of risk and need for self-harm patients.

Previous research has found that hospital care following self-harm presentations to hospital varies depending on the method used, where self-cutting patients were less likely to receive a psychosocial assessment (Lilley et al., 2008). Attitudes to individuals presenting with self-harm vary among

healthcare staff (Taylor et al., 2009) and may conceivably contribute to less than optimal experience of care. Minor self-cutting and self-harm by blunt object were identified as significant predictors of repetition. This highlights the necessity for assessment and intervention even if the injuries sustained require little or no medical treatment (Larkin et al., 2014a; Lilley et al., 2008) as they are likely to recur. The study also identified increased severity of self-cutting, a method characteristic previously associated with high lethality repeat presentations (Larkin et al., 2014a), as a predictor of repetition. There is a need for staff educational initiatives and care pathways for plastics surgery services to ensure that all such presentations receive a timely psychosocial assessment. Consideration should also be given to mental health service provision of enhanced follow-up for self-cutting presentations that require sutures or plastics intervention.

International guidelines highlight the critical role that clinicians' prescribing practices play in self-harm management and suicide prevention (NICE, 2004, 2011; World Health Organization, 2014). The increased repetition risk associated with multiple drug IDOs in our sample underline the importance of monitoring the availability of multiple drugs, particularly to patients prescribed psychotropic drugs. Furthermore, due to the potential dangers associated with some psychotropic drugs, care should be taken where possible to prescribe drugs that are least toxic in IDO (NICE, 2004, 2011). Ongoing awareness training with clinicians may be beneficial to reduce inappropriate prescribing of drugs commonly used in IDO that are associated with increased risk of repetition (World Health Organization, 2014). Limiting the duration/amount of medication prescribed and dispensed for self-harm patients should be considered as a matter of routine. Collaboration with carers to reduce availability of and access to other medication at home should be a routine part of safety planning.

A word of caution is that due to the frequency of method switching between presentations (Owens et al., 2015), characteristics of self-harm method alone should never be used as static predictors of subsequent repetition. We found that risk of repeated self-harm was high irrespective of the method and a person's risk increased substantially with each repeat presentation. All presentations following self-harm regardless of method, should receive a standard of assessment and care that includes standardised triage, bio-psycho-social assessment, access to skilled clinicians, involvement of family/carers, emergency care plans and appropriate follow-up (Health Service Executive, 2017; NICE, 2004, 2011).

Author Contribution

GC, PC, EA and DL conceived of and designed the study. GC drafted the manuscript. EG, CD and PC were responsible for data collection and preparation of the dataset. GC and PC conducted statistical analyses and interpreted the data. GC, PC, DL, EG, CD, FS, EC and EA assisted with interpretation of the data and commented on drafting the manuscript. All authors read and approved the final manuscript.

Role of Funding Source

This work was supported by the Irish Health Research Board (grant number: IRRL-2015-1586). The National Self-Harm Registry Ireland is funded by the Irish Health Service Executive's National Office for Suicide Prevention. The funding sources had no involvement in study design, collection, analysis and interpretation of data, writing of the report or in the decision to submit the article for publication.

Acknowledgments

The authors would like to acknowledge those who contributed to the development of the National Self-Harm Registry Ireland, particularly Professor Ivan J Perry, Head of the School of Public Health, University College Cork, and Ms Eileen Williamson, Chief Executive Officer of the National Suicide Research Foundation. The authors would also like thank the data registration officers who collected the data and to the staff of the hospitals who facilitated the data collection.

Competing Interests

The authors have no competing interests.

CONFLICT OF INTEREST

None.

References

Arensman, E., Griffin, E., Daly, C., Corcoran, P., Cassidy, E., Perry, I.J., 2018. Recommended next care following hospital-treated self-harm: patterns and trends over time. PloS One 13, e0193587.

Bergen, H., Hawton, K., Waters, K., Cooper, J., Kapur, N., 2010. Psychosocial assessment and repetition of self-harm: the significance of single and multiple repeat episode analyses. J. Affect. Disord. 127, 257-265.

Bergen, H., Hawton, K., Waters, K., Ness, J., Cooper, J., Steeg, S., Kapur, N., 2012. How do methods of non-fatal self-harm relate to eventual suicide? J. Affect. Disord. 136, 526-533.

Birtwistle, J., Kelley, R., House, A., Owens, D., 2017. Combination of self-harm methods and fatal and non-fatal repetition: a cohort study. J. Affect. Disord. 218, 188-194.

Carroll, R., Metcalfe, C., Gunnell, D., 2014. Hospital presenting self-harm and risk of fatal and non-fatal repetition: systematic review and meta-analysis. PLoS One 9, e89944.

Carter, G., Reith, D.M., Whyte, I.M., McPherson, M., 2005. Repeated self-poisoning: increasing severity of self-harm as a predictor of subsequent suicide. Br. J. Psychiatry 186, 253-257.

Chan, M.K., Bhatti, H., Meader, N., Stockton, S., Evans, J., O'Connor, R.C., Kapur, N., Kendall, T., 2016. Predicting suicide following self-harm: systematic review of risk factors and risk scales. Br. J. Psychiatry 209, 277-283.

Cooper, J., Kapur, N., Dunning, J., Guthrie, E., Appleby, L., Mackway-Jones, K., 2006. A clinical tool for assessing risk after self-harm. Ann. Emerg. Med. 48, 459-466.

Corcoran, P., Heavey, B., Griffin, E., Perry, I.J., Arensman, E., 2013. Psychotropic medication involved in intentional drug overdose: implications for treatment. Neuropsychiatry 3, 285.

Daly, C., Griffin, E., Ashcroft, D.M., Webb, R.T., Perry, I.J., Arensman, E., 2018. Frequently used drug types and alcohol involvement in intentional drug overdoses in Ireland: a national registry study. Eur. J. Public Health doi: 10.1093/eurpub/cky031.

Geulayov, G., Kapur, N., Turnbull, P., Clements, C., Waters, K., Ness, J., Townsend, E., Hawton, K., 2016. Epidemiology and trends in non-fatal self-harm in three centres in England, 2000–2012: findings from the Multicentre Study of Self-Harm in England. BMJ Open 6, e010538.

Grambsch, P.M., Therneau, T.M., 1994. Proportional hazards tests and diagnostics based on weighted residuals. Biometrika 81, 515-526.

Haw, C., Casey, D., Holmes, J., Hawton, K., 2015. Suicidal intent and method of self-harm: a large-scale study of self-harm patients presenting to a general hospital. Suicide Life Threat. Behav. 45, 732-746.

Hawton, K., Bergen, H., Casey, D., Simkin, S., Palmer, B., Cooper, J., Kapur, N., Horrocks, J., House, A., Lilley, R., 2007. Self-harm in England: a tale of three cities. Soc. Psychiatry Psychiatr. Epidemiol. 42, 513-521.

Health Service Executive, 2017. National Clinical Programme for the Assessment and Management of Patients Presenting to the Emergency Department following Self-Harm: Review of the Operation of the Programme 2017. Health Service Executive, Mental Health Division., Dublin.

Hori, S., Kinoshita, K., 2016. Clinical characteristics of patients who overdose on multiple psychotropic drugs in Tokyo. J. Toxicol. Sci. 41, 765-773.

Larkin, C., Corcoran, P., Perry, I., Arensman, E., 2014a. Severity of hospital-treated self-cutting and risk of future self-harm: a national registry study. J. Ment. Health 23, 115-119.

Larkin, C., Di Blasi, Z., Arensman, E., 2014b. Risk factors for repetition of self-harm: a systematic review of prospective hospital-based studies. PLoS One 9, e84282.

Lilley, R., Owens, D., Horrocks, J., House, A., Noble, R., Bergen, H., Hawton, K., Casey, D., Simkin, S., Murphy, E., 2008. Hospital care and repetition following self-harm: multicentre comparison of self-poisoning and self-injury. Br. J. Psychiatry 192, 440-445.

Mergl, R., Koburger, N., Heinrichs, K., Szekely, A., Toth, M.D., Coyne, J., Quintao, S., Arensman, E., Coffey, C., Maxwell, M., Varnik, A., van Audenhove, C., McDaid, D., Sarchiapone, M., Schmidtke, A., Genz, A., Gusmao, R., Hegerl, U., 2015. What Are Reasons for the Large Gender

Differences in the Lethality of Suicidal Acts? An Epidemiological Analysis in Four European Countries. PLoS One 10, e0129062.

Neeleman, J., Wessely, S., 1997. Drugs taken in fatal and non-fatal self-poisoning: a study in South London. Acta Psychiatr. Scand. 95, 283-287.

NICE, 2004. Self-harm: the short-term physical and psychological management and secondary prevention of self-harm in primary and secondary care (Guideline CG16). London: National Institute for Health and Clinical Excellence

NICE, 2011. Self-harm: longer-term management (Clinical guideline CG133.), London: National Institute for Health and Clinical Excellence.

Owens, D., Dennis, M., Read, S., Davis, N., 1994. Outcome of deliberate self-poisoning. An examination of risk factors for repetition. Br. J. Psychiatry 165, 797-801.

Owens, D., Kelley, R., Munyombwe, T., Bergen, H., Hawton, K., Cooper, J., Ness, J., Waters, K., West, R., Kapur, N., 2015. Switching methods of self-harm at repeat episodes: findings from a multicentre cohort study. J. Affect. Disord. 180, 44-51.

Perry, I.J., Corcoran, P., Fitzgerald, A.P., Keeley, H.S., Reulbach, U., Arensman, E., 2012. The incidence and repetition of hospital-treated deliberate self harm: findings from the world's first national registry. PLoS One 7, e31663.

Platt, S., Bille-Brahe, U., Kerkhof, A., Schmidtke, A., Bjerke, T., Crepet, P., Leo, D.D., Haring, C., Lonnqvist, J., Michel, K., 1992. Parasuicide in Europe: the WHO/EURO multicentre study on parasuicide. I. Introduction and preliminary analysis for 1989. Acta Psychiatr. Scand. 85, 97-104.

Runeson, B., Tidemalm, D., Dahlin, M., Lichtenstein, P., Långström, N., 2010. Method of attempted suicide as predictor of subsequent successful suicide: national long term cohort study. BMJ (Clin. Res. Ed.) 341, c3222-c3222.

Sinclair, J.M., Gray, A., Rivero-Arias, O., Saunders, K.E., Hawton, K., 2011. Healthcare and social services resource use and costs of self-harm patients. Soc. Psychiatry Psychiatr. Epidemiol. 46, 263-271.

Skogman, K., Alsén, M., Öjehagen, A., 2004. Sex differences in risk factors for suicide after attempted suicide. Soc. Psychiatr. Epidemiol. 39, 113-120.

Taylor, T.L., Hawton, K., Fortune, S., Kapur, N., 2009. Attitudes towards clinical services among people who self-harm: systematic review. Br. J. Psychiatry 194, 104-110.

Tournier, M., Grolleau, A., Cougnard, A., Molimard, M., Verdoux, H., 2009. Factors associated with choice of psychotropic drugs used for intentional drug overdose. Eur. Arch. Psychiatry Clin. Neurosci. 259, 86.

Townsend, E., Hawton, K., Harriss, L., Bale, E., Bond, A., 2001. Substances used in deliberate self-poisoning 1985–1997: trends and associations with age, gender, repetition and suicide intent. Soc. Psychiatry Psychiatr. Epidemiol. 36, 228-234.

World Health Organization, 2008. International statistical classification of diseases and related health problems. World Health Organization, Geneva.

World Health Organization, 2014. Preventing suicide: a global imperative. World Health Organization, Geneva.

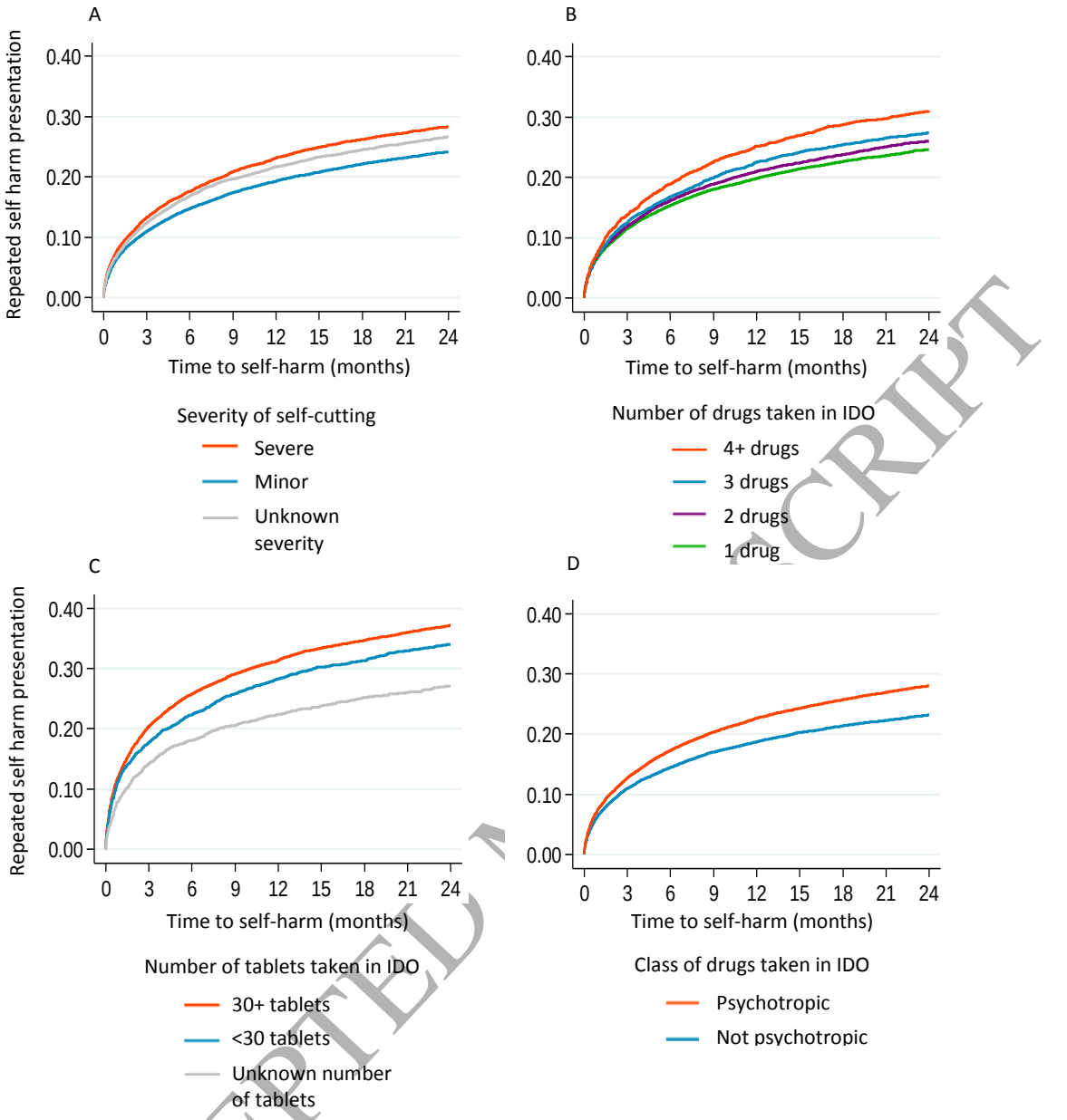

Figure 1. Kaplan-Meier failure curves showing the cumulative probability of a repeated self-harm presentation. The curves show the cumulative probability of a repeated self-harm presentation in the 24 month period after an index self-harm presentation. Variation in the probability of a repeated self-harm presentation is shown by severity of self-cutting (A) by number of drugs taken in intentional drug overdose (IDO) (B) by number of tablets taken in IDO (C) and by the class of drug taken in IDO (D).

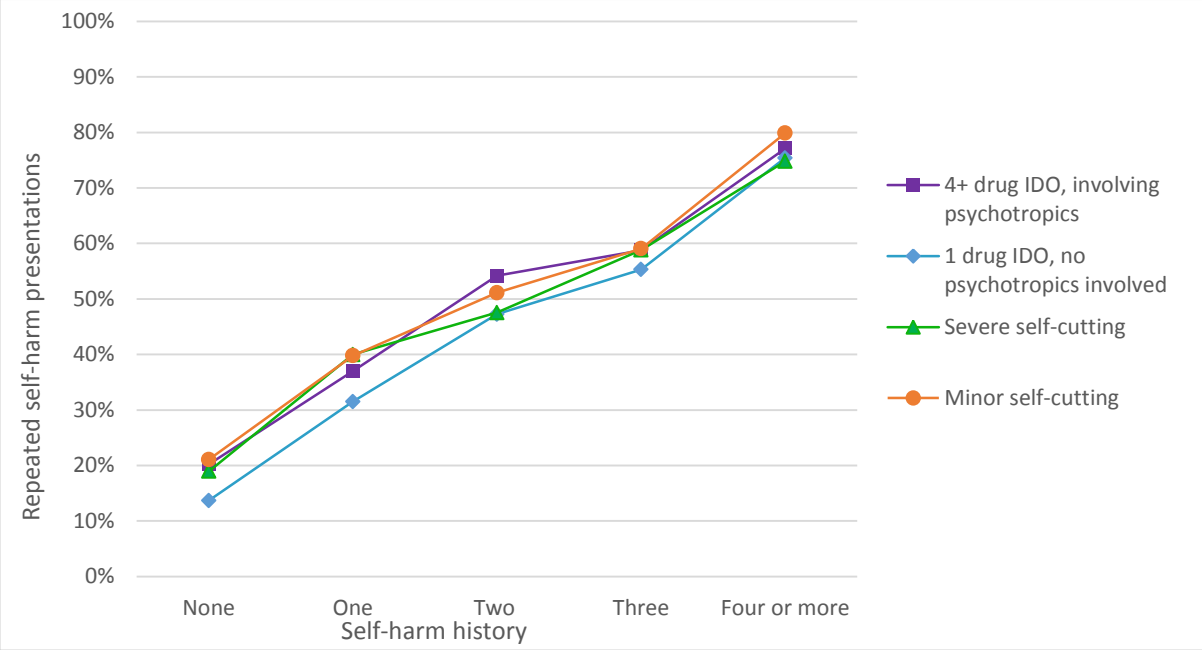

Figure 2. Proportion of repeat presentations in the 24 month period after an index self-harm presentation. Proportion is shown by number and class of drugs taken in IDO, severity of self-cutting and previous self-harm history.

Table 1 Characteristics of all self-harm presentations and repeat presentations, 2010-2016 and Cox proportional hazard survival analyses for time to subsequent self-harm repetition during 2010–2016.

Variable	All self-harm presentations		Repeated self-harm presentation		Univariate Cox proportional hazard survival analysis	
	n	%	n	%	Hazard ratio (95% CI)	*p*
All presentations	65,690	100	19,029	29.0		
Intentional drug overdose (IDO) (X60-X64)	44,890	31.7	12,433	27.7	0.83 (0.79-0.87)	<0.001
Number of drugs taken in IDO (X60-X64)						
1 drugs taken	24,130	36.7	6,335	26.3	0.78 (0.74-0.82)	<0.001
2 drugs taken	11,038	16.8	3,122	28.3	0.84 (0.79-0.89)	<0.001
3 drugs taken	5,756	8.8	1,675	29.1	0.87 (0.81-0.93)	<0.001
4+ drugs taken	3,960	6.0	1,301	32.9	1.00 (0.92-1.08)	0.971
Drug class(s) taken in IDO						
Psychotropic	25,260	38.5	7,600	30.1	0.90 (0.69-0.77)	<0.001
Analgesic	18,830	28.7	7,706	25.1	0.74 (0.70-0.78)	<0.001
Other	11,803	18.0	3,231	27.4	0.82 (0.78-0.87)	<0.001
Number of tablets taken in IDO(X60-X64)						
<10 tablets	5,221	8.0	1,342	25.7	0.75 (0.70-0.81)	<0.001
10-19 tablets	9,012	13.7	2,335	25.9	0.77 (0.72-0.82)	<0.001
20-29 tablets	6,777	10.3	1,797	26.5	0.78 (0.73-0.83)	<0.001
30-39 tablets	3,700	5.6	1,094	29.6	0.89 (0.82-0.92)	0.003
40-49 tablets	2,460	3.7	769	31.3	0.95 (0.87-1.03)	0.215
50-59 tablets	1,462	2.2	437	29.9	0.91 (0.81-1.02)	0.100
60-69 tablets	1,080	1.6	331	30.7	0.92 (0.82-1.04)	0.179
70-79 tablets	594	0.9	175	29.5	0.87 (0.75-1.02)	0.096
80 tablets+	1,721	2.6	510	29.6	0.88 (0.79-0.98)	0.018
Unknown quantity of tablets	12,863	19.6	3,643	28.3	0.86 (0.81-0.90)	<0.001
Self-cutting (X78)	15,616	23.8	5,638	36.1	1.50 (1.42-1.58)	<0.001
Severity of self-cutting (X78)						
Minor self-cutting	10,309	15.7	3,886	37.7	1.62 (1.52-1.72)	<0.001
Severe self-cutting	3,414	5.2	1,202	35.2	1.41 (1.30-1.53)	<0.001
Unknown severity self-cutting	1,893	2.9	551	29.1	1.07 (0.94-1.23)	0.318
Attempted hanging (X70)	4,335	6.6	1,199	27.7	0.96 (0.89-1.02)	0.165
Attempted drowning (X71)	1,967	3.0	553	28.1	0.97 (0.88-1.06)	0.499
Self-poisoning (X66-69)	1,329	2.02	315	23.7	0.79 (0.70-0.89)	<0.001
Jumping from a height (X81)	818	1.25	208	25.4	0.88 (0.77-1.02)	0.087
Blunt object (X79)	601	0.9	209	34.8	1.36 (1.16-1.59)	<0.001
Jumping in front of moving object (X81)	456	0.7	144	31.6	1.23(1.04-1.47)	0.049
Crashing motor vehicle (X82)	273	0.4	54	19.8	0.65 (0.50-0.85)	0.001
Alcohol involved	23,160	35.3	6,661	28.8	0.95 (0.91-0.99)	0.021
Sex						
Male	30,597	46.6	8,824	28.8	1	
Female	35,093	53.4	10,205	29.1	1.01 (0.95-1.08)	0.319
Age						
<15yrs	2,201	3.35	599	27.2	0.91 (0.80-1.02)	0.103
15-24 yrs	22,094	33.6	6,365	28.8	0.95 (0.88-1.01)	0.095
25-44 yrs	27,094	41.3	8,276	30.6	1	
45-64 yrs	12,536	19.1	3,537	28.2	0.911 (0.84-0.99)	0.020
65+yrs	1,765	2.7	252	14.3	0.434 (0.36-0.52)	<0.001
Self-harm history						
No previous presentations	46,661	71.0	9,166	19.6	1	
1 previous presentation	9,166	14.0	3,591	39.2	2.46 (2.37-2.56)	<0.001
2 previous presentations	3,591	5.5	1,809	50.4	3.69 (3.51-3.88)	<0.001
3 previous presentations	1,809	2.8	1,058	58.5	4.91 (4.61-5.23)	<0.001
4+ previous presentations	4,463	6.8	3,405	76.3	9.44 (8.73-10.21)	<0.001

Note:. For each method of self-harm variable, the reference category is all presentations not involving that method. Repeated self-harm percentages represent the proportion of those who represented to hospital as a result of self-harm out of the total number of presentations within the relevant category.

Table 2 Multivariate Cox proportional hazard survival analyses for time to subsequent self-harm repetition during 2010–2016.

Variables	Total	
	Hazard ratio (95% CI)	*p*
Number of drugs taken and class of drug taken in intentional drug overdose (IDO) (X60-X64)		
No psychotropic, 2 drugs	0.94 (0.88-1.02)	0.135
No psychotropic, 3 drugs	0.78 (0.69-0.88)	<0.001
No psychotropic, 4 drugs	0.95 (0.81-1.11)	0.493
Psychotropic, 1 drug	1.06 (1.01-1.12)	0.024
Psychotropic, 2 drugs	1.15 (1.09-1.22)	<0.001
Psychotropic, 3 drugs	1.17 (1.10-1.25)	<0.001
Psychotropic, 4 drugs	1.29 (1.20-1.39)	<0.001
Self-cutting (X78)		
Minor self-cutting	1.38 (1.31-1.45)	<0.001
Severe self-cutting	1.25 (1.16-1.34)	<0.001
Unknown severity self-cutting	1.10 (0.99-1.22)	0.086
Attempted hanging (X70)	1.04 (0.98-1.11)	0.223
Attempted drowning (X71)	1.01 (0.93-1.10)	0.809
Self-poisoning (X66-69)	0.85 (0.76-0.96)	0.007
Jumping from a height (X81)	0.93 (0.81-1.07)	0.298
Blunt object (X79)	1.23 (1.07-1.42)	0.003
Jumping in front of moving object (X81)	1.13 (0.95-1.33)	0.162
Crashing motor vehicle (X82)	0.87 (0.66-1.13)	0.298
Alcohol involved	0.96 (0.93-1.00)	0.031
Sex (female)	1.01 (0.97-1.05)	0.723
Age		
<15yrs	1.17 (1.07-1.28)	<0.001
15-24yrs	1.00 (0.95-1.04)	0.843
25-44yrs	1	
45-64yrs	0.94 (0.89-0.99)	0.016
65+yrs	0.58 (0.51-0.67)	<0.001
Previous self-harm presentations		
1 previous presentation	2.39 (2.30-2.49)	<0.001
2 previous presentations	3.55 (3.37-3.73)	<0.001
3 previous presentations	4.69 (4.39-5.00)	<0.001
4+ previous presentations	8.93 (8.26-9.63)	<0.001

Note: For all method of self-harm variables, the reference category is 'no psychotropic, 1 drug' IDO.